Technical Report No. 67

USER ORIENTED STATISTICAL ANALYSIS PROGRAMS

A BRIEF GUIDE

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PREFACE

There has been a strong emphasis on using computers to process the data obtained in the Island Ecosystems IRP. In nearly all cases, however, the actual use of the computer ha8 been by the Data Processing staff on the data submitted by researchers. In many ways such an arrangement has been necessary. But there are many times when a user should be able to get directly to the computer and run his own analyses. The set of statistical routines included in this report are, in part, an experiment in providing this capability.

The report, and the programs themselves, do not assume any prior experience with computers. It is assumed that a user will have some basic familiarity with the type of statistical analysis which he will want to perform. No instructions regarding the choice of tests or their interpretation are given here.

ABSTRACT

A set of seven statistical analysis programs has been made available for use on an interactive mini-computer. These programs are designed for easy use and should allow novice computer users a convenient way to analyze their data. This report presents the information on how *to* gain access to the computer through a time-sharing terminal and how to use the programs.

The programs perform the following types of analyses: simple sample descriptions and histogram plots, t-tests on unpaired samples, one-way analysis of variance, least squares regressions with linear and various equations for curves with plots of the fit equations, polynomial regressions, multiple regressions, and contingency tables.

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INTRODUCTION

There are now many ways to perform the calculations required for running statistical analyses. We can do it by hand or with a simple calculator, or we can go to the other extreme and use a large scale computer. Each technique has its advantages and disadvantages. While observing the use of this range of techniques, it has become apparent that there may be some intermediate solution to the computation problem which should be more fully explored. What is being sought is a computation device which will perform statistical analyses for people with little or no experience with computers but which will preserve some of the advantages of using computers.

Calculators are increasing in their capability to do many standard analyses. In this regard, they are approaching what we consider the realm of true computers; they can store programs and run data through the program on demand. In practice, however, there are still some significant differences between most calculators and computers.

Both kinds of equipment have decreased the difficulty of performing the computations for statistical analyses. Even fairly "simple" calculators are available which will calculate simple statistics based on only the entry of the data; an elaborate data entry technique is not required. The primary difference between using a computer and a calculator when doing such simple statistics is the way in which data are handled. Ordinarily, data are entered on the keyboard of the calculator and are used in the computations but not stored. With a computer, data are entered (such as on a keypunch) and stored. The storage of data allows it to be modified and rerun with some assurance that the only change in the data is in the modification itself. If all the data are reentered, as with a calculator, there is a great chance of making an error in entering a datum which was previously entered correctly. While the problem of data entry does not seem severe with small amounts of data, most people greatly misjudge how many numbers make up a small amount of data.

Another basic difference between computers and calculators is the way they are used to present data. Calculators generally display (or print if they have a tape printer) only the number which is the "answer." Computers generally use some type of printer which has the ability to also print text so that the "answers" are identified. Since most statistical analyses have many numbers which are of interest, it is more convenient to have a descriptive printed record.

The disadvantage with using computers seems, for most people, to be in learning the great number of detailed operations which seem to be required to perform even very simple analyses. It often involves the assistance of some programmer until the pattern of operations has been mastered. Yet when the analyses get through the computer smoothly, the resulting ease of performing successive analyses on corrected data generally causes us to forget the difficulties of setting up the procedure.

The purpose of the programs which are discussed here is to explore an intermediate technology. This is based on the use of a time-shared mini-computer. Briefly, this system has been designed to make the computer nearly as available as a calculator yet to preserve the ability to store and edit data and run statistical analyses which are well annotated. Moreover, there has been some attempt to do this at a relatively low cost. The printouts have been designed to provide a wide selection of materials including tables and graphs.

It will be easy to use these programs if you learn a few simple procedures. The sequence which you should go through to master the computer operations is to learn the following:

1. How to establish contact with the computer.
2. How to get example data and programs from the computer storage.
3. How to run the example data with the programs.
4. How to enter your own data and store it.
5. How to run your data with the programs.
6. How to modify your data and rerun it.

Each of these topics will form a section of this discussion.

Before you start, however, there are two important items of advice. First, there is probably nothing you can do that will upset anything in the computer. Even if you make a mistake, it will not cause any sort of damage, except perhaps that you may have to reenter some of your own data. So plunge in and try. If something you do doesn't seem to work as you expected it would, try an alternative. This is how you will find out what you want to do. Be sure to use the example data for your first practice with the programs. Compare the answers you get with those listed in the Appendices of this report.

Also, get to a computer terminal as soon as possible. Experience using the computer will soon convince you that it really is very easy. In general, using the computer is easier than reading about what to do.

The series of seven statistical programs which are described in the Appendices should satisfy many analysis needs. It is expected that new programs will be added when necessary. To find out what programs are available at any time, GET and RUN the program named $+STATS; the description of how to do this is explained later.

There will be some changes made to the programs as new capabilities are required or general improvements are recognized. If you encounter slight differences between your use of the programs and the examples given here, don't be too surprised.

There are several differences between the notation used by the computer and that which is more familiar to you. The multiplication sign is an asterisk (*). The sign for exponentiation is either an ↑ or a ∧ ; the exponential factor is printed on the same line as the base. For example, three times X squared is given as 3*X∧2. Scaling of numbers, such as you do with scientific notations, is employed. An E-02 printed following a number is equivalent to x 10^{-2} meaning that you move the decimal point two places to the left.

A FEW HINTS ABOUT TYPING ON A TELETYPE TERMINAL

We all make typing errors. Since we must be precise in what we type to the computer, we must have a way to correct our typing errors. Here are a few things to do.

Remember that every line you type **must** end with a carriage return. If you find an error in your typing before you have pressed the carriage return at the end of the line, there are *two* ways to correct the error.

Backspacing. If the typing error occurred as the previous character, or within the last 3 or 4 characters, you can "backspace" by typing a ← (which is an uppercase letter O). Type one back arrow for each backspace. Then type starting from your new position. The print mechanism actually has moved ahead as you type each back arrow, but the computer knows that each is a backspace.

Line erase. If you want to erase the entire line you have entered (before you have pressed the carriage return), hold down the CTRL key and press **X. The** computer responds with a carriage return and you can then enter the whole line again.

If you have already pressed the carriage return and you are typing sequence numbered statements follow the instructions below.

Changing numbered statements. Simply retype the statement using **the same** statement number as the one which is in error. If you only type the sequence number and then the carriage return key, it will remove that numbered statement.

HOW TO ESTABLISH CONTACT WITH THE COMPUTER

The computer which we will use is a small, time-shared computer. It is available for use only through a teletype-like terminal; there is no card reader so you can't use punched cards. By being time-shared, it means that many people can be connected to the computer at the same time. Each person is served as though he were the only one using the machine.

The basic operations for connecting with the computer depend on whether you are using a terminal which is wired directly to the computer or one which connects via a telephone link. We are assuming here that you are using a direct wired terminal.

Turn the terminal on to the **LINE** position. The knob on the teletype is on the front, right-hand corner.

Next type on the keyboard a message in the following form:

HELLO-account,(CTRL)password(CR)

The account and password are your private numbers which tell the machine who you are and what files you can use. There are a few things to remember when typing this. As you enter your password you must hold the CTRL key down. **As** you type, nothing is printed (it is kept a secret **so** nobody else will use your account). At the end of the line press the carriage return (CR). You must always do this at the end of the line to tell the machine you are done typing.

If all has gone well, the computer will start typing some information back to you, It consists of various messages regarding the use of the computer, such as how many days since the last problem, new programs available for use, etc. When you have seen enough, press the BREAK key and the computer will type STOP. It is now waiting for you to give it instructions.

If you didn't do everything right while establishing contact, the computer types three question marks or the words **ILLEGAL** ACCESS. This is the general response it gives when it can't figure out what is happening. Try again. If you still have trouble, ask somebody.

To terminate your session on the computer type BYE and the computer will respond with how many minutes you have been connected. Turn off the terminal.

It is very important that you always end a session by typing BYE. If you just turn the terminal off, the computer thinks you are still there. It will continue to charge you **as** though you are there and the next person to use the terminal will be able to use your account and files, possibly with disasterous results to you! Just remember, always end by typing BYE, and making sure you get the connect-time message.

HOW TO GET EXAMPLE DATA AND PROGRAMS FROM THE COMPUTER STORAGE

One of the advantages in using a computer, as was discussed earlier, was in our ability to store data and programs within the computer for later use. There are two types of libraries in which such items are stored. The system itself has a library of items which you can use. Any user of the computer has access to these items by moving a copy to his current program space. Each user also has his own library. He alone has access to this.

Each item in a library has a name. Those in the system library start with a $ sign. To use any item, it must be copied from a library and made the current program (or data-set). This is done simply by typing

GET-XXXXXX

where the XXXXXX is the name of the item. To get the program which describes how to run the statistical programs, for example, type

GET-$+STATS

The $ as the first letter of the name indicates that you are getting it from the system library.

A listing of the names of the programs which you may want to use from the system library is given in Appendix 1. These are also given when you use the $+STATS program.

You can store programs and data in your own library. To find out what is in your library, type

CAT

which tells the computer to type the names and lengths of your library catalog. Instructions are given later on how to store items in your library. First, you should get familiar with using programs.

HOW TO RUN PROGRAMS

Before you are ready to run a program, it is important that you have a little more background on the way that the computer stores programs and data. This will make it easier to do things later.

Each program consists of a series of sequence numbered statements. The numbers identify the order of the operations which are given as the statements. The numbers need not be consecutive; they are used simply in ascending order by skipping any missing numbers. Therefore, every line of a program must be sequence numbered. The range of numbers is from 10 to 9999.

When a program needs data input to do its calculations, it may either get it by asking for entry from the keyboard and pausing until some number or set of numbers are typed in, or it may read the numbers from a DATA statement. We use both forms of input; which one is used is controlled by the way that a program is designed. The observation data on which you will run your analysis will always be stored as DATA statements.

A DATA statement is actually part of a program. It may have any sequence number, as long as that number is not already used as a program statement. So that this overlap will not happen, it is suggested that you number your DATA statements in the range from 10 to 1000. Values are read from these statements in the order in which they are entered on the line, with the order of the lines determined by the sequence numbers of the statements. An example of a set of data statements will be given directly.

One other type of statement is the remark, abbreviated REM. The remark statements are also given as sequence numbered statements. They provide you with a way to place comments within the set of DATA statements. It is very important that you make liberal use of appropriate remarks so that you will have reminders of what you have done for later reference.

An example of a set of DATA and REM statements is given below.

```
10 REM - FIELD RESULTS, 3/18/75, WAIKIKI
11 REM - TRANSECT 1
20 DATA 3,17,4.2,23,5.7,31,6.1,40,7.9,53
25 DATA 9.2,73,11.4,103,13.6,109
30 REM - END OF TRANSECT 1 OBSERVATIONS
```

You don't need to worry about what the numbers mean now. First, it is important to see how to use this set of DATA and REM statements. We will refer to a set of this type of statements as a data-set.

A program consists of a series of sequence numbered statements. What we want to do is append these program statements to our data-set. We do this by typing

APPEND-YYYYYY

where YYYYYY is the name of the program.

The operations we will want to use for running the simple sample description program (named $+SAMPL) on the example data set named $+EX01 are entered by typing the following two lines:

GET-$+EX01

APPEND-$+SAMPL

In order to run the program, simply type

RUN

As the program runs, it will ask you for responses.

Each of the statistical analysis programs has an example data-set. Choose the analysis you are most interested in, GET the example data-set, APPEND the program, and RUN it.

HOW TO ENTER YOUR OWN DATA AND STORE IT

Your data must be recorded in precisely the correct order for your analysis to be run properly. There are three general ways to find out how your data should be entered for any particular analysis. If you GET and RUN the program $+STATS, you will be given instructions on running all the analysis programs. If you already know the name of the program that you want to use, GET it and RUN it without data. It will print the instructions for preparing the data. You may also use the instructions given in the Appendices of this report.

Even if you have read the instructions for preparing your data, it is a good idea to look at an example data-set. To list any data-set (or program) first GET it then type

LIST

When you have seen enough, press the BREAK key to stop the listing. The REM statements in the examples are intended to give you further guidance.

Before you enter your own data there are two things which you should always do.

1. Clear the computer's current program space by typing

   SCR

2. Name the data-set you are going to build by typing

   NAME-XXXXXX

   where XXXXXX is the name you want to use. It may be a maximum of *6* letters long; it helps if it has some easily remembered qualities.

When you build your data-set, it is a very good practice to make the first statement (i.e., the lowest number, 10 or larger) a REM statement and identifying the data-set with your name, where the data are from, what analysis they will be used with, and the date the data-set was created. Type the REM and DATA statement following these guidelines.

1. Start every line with a sequence number.
2. Follow the sequence number with either REM or DATA, depending on the type of statement you are entering.
3. Enter your numbers, separating numbers by a comma. You may have spaces after a comma, although they will be deleted by the computer before the statement is stored.
4. Do not put a comma on the end of a statement, even if the data are to be continued on the next statement.

5. If you make a typing error, follow the instructions given in the section describing how to type on a teletype terminal.

When your data are entered, you can save the data-set by typing

SAVE

This operation saves a copy on the computer storage disk. Your data-set also remains as the current program.

To find out what data-sets and programs are stored for later use, type

CAT

and your storage catalog will be listed.

One last warning. Be sure to SAVE your data-set before running it with an analysis program.

HOW TO RUN YOUR DATA WITH THE PROGRAMS

Your data-set should be in the form of a set of REM and DATA statements. This is exactly what you used before with the example data-sets. To run a program with your own data you follow the same procedure.

Your data-set must be the current program. If you have just created it, then it is already the current program. (Make sure that you SAVE it before going further.) If it is not the current program, or you are not sure, GET it, as explained earlier.

Find out the name of the program to perform the analysis. These are given in the $+STATS instructions or may be found in Appendix 1 of this report. You want to append the program to your data. Do this by typing

APPEND-YYYYYY

where YYYYYY is the name of the program.

To run the program, type **RUN.** Your data will then be analyzed by the program. If the program does not run correctly, check the form of your data and the program limitations. Hints are given in the Appendices.

HOW TO MODIFY YOUR DATA AND RERUN IT

If you have already saved your data-set and want to madify it, you first have to make it the current program. Do this by using the GET command with the appropriate name. When you GET your data-set from the storage, you are really getting a copy of what is stored.

To change any statement, you will have to retype the sequence number and the statement itself. If the sequence number already exists, the new statement replaces the old one. If it is a new sequence number, the statement will be entered in its appropriate place in the sequence. This allows you to add new statements on the end or to insert them.

A sequence number typed without a statement will delete a statement which has that number.

When you want to see what your data-set is like, you can list it by typing

LIST

As usual, stop the listing by pressing the BREAK key. If your listing includes the program following your listing, you will have to delete the program portion. Do this by first noting the starting number of the program and then typing

DEL-start,9999

where start is the sequence number of the first program statement.

To save the current version of your data-set, you must first get rid of your previous version from the storage (you KILL it) and then SAVE the current version. To do this type the following

KIL-XXXXXX

SAVE

where XXXXXX is the name of your data-set.

If you want to make sure that everything is as you think that it should be, GET your data-set and then LIST it.

APPENDIX 1.

CURRENTLY AVAILABLE STATISTICAL PROGRAMS

Program name	Use, features	Example data-set name
$+SAMPL	Simple sample descriptions. Gives the sample mean, standard deviation, and plots a histogram.	$+EX01
$+TTEST	t-test on unpaired samples. Gives each sample mean, standard deviation, and tests significance. Plots the two normal curves.	$+EX02
$+ANOV1	One-way analysis of variance.	$+EX03
$+CURVE	Least squares regression. Uses straight-line fit plus 6 types of curves. Plots lines of choice.	$+EX04
$+POLYR	Polynomial regression.	$+EX05
$+MULTR	Multiple regression.	$+EX06
$+CONTG	Contingency tables.	$+EX07

APPENDIX 2.

PROGRAM NAME: $+SAMPL

GENERAL DESCRIPTION:

This program is run to obtain the number of observations, mean, and standard deviation of the sample. The data can be used to plot a frequency histogram. Since the number of cells (or intervals) is not readily determined in a program, the user **is** asked to supply both the starting point of the first cell and the cell width. **Note** that all of the cells are the same width. **A** maximum of **100** cells can be used. **If** your data are such that they exceed this number, a message will be printed and you can respecify a larger cell width.

PROGRAM LIMITATIONS:

A maximum of 100 observations may be used in the analysis.

PROGRAM HISTORY:

This program **is** a modffied version of the program $HISTOG from the ***HP*** library.

HOW TO USE:

1. Enter each **of** the sample observations on numbered data statements.
2. Be sure to **NAME** and **SAVE** the data-set.
3. If you are using a data-set which you entered during **a** previous session and stored, get it back by typing

   GET-XXXXXX where XXXXXX is the name.
4. **To** get the analysis program, type

   APPEND-$+SAMPL
5. **To** run the program with the data, type

   RUN
6. **To** see how the program works on some example data, use the data-set named '$+EX01'.

EXAMPLE **DATA-SET:** $+EX01

```
10  REM **** EXAMPLE DATA FUR THE SIMPLE POPULATION DESCRIPTIUN PROGRAM
15  REM **** ONLY THE OBSERVATION DATA NEED BE GIVEN
20  DATH 50.2,34.6,45.4,55.3,47.5,64.3,51.9,38.5,39.2,46.3562.4
30  DHTA 42.5,66.8,37.5,53.9,48.6,51.7,39.9,44.7,49.2,53.5,61
40  DATA 54.4,42.6,57.8s 60.1,56.3,47.5,58.5,61.2,46.4,44.6,57.4
50  DATA 47.79 54.9,51,2939.5,54.8,50.2,51'4
60  REM **** NO MORE DATA
```

EXAMPLE RUN **USING** DATA-SET $+EX01:

```
      SAMPLE SIZE = 40
      MEAN = 50.535
      STANDARD DEVIATION = 7.8903

DO YOU WANT A FREQUENCY HISTOGRAM?YES

THE RANGE OF OBSERVED VALUES IS FROM 34.6        TO 66.8

WHAT VALUE FOR THE FIRST CELL (IT SHOULD BE LESS THAN
 OR EQUAL TO THE MINIMUM OF THE RANGE)?30
WHAT CELL WIDTH?5

                   FREQUENCY AS % OF MAXIMUM
CLASS      0        20        40        60        80       100
           !         !         !         !         !         !
           +---------+---------+---------+---------+---------+
 30       -!****
          -!**********************
          -!******************
          -!*************************************
          -!****************************************************
 55       -!**********************
          -!**********************
          -!****
          -!

DO YOU WANT TO PRINT A NEW HISTOGRAM WITH A DIFFERENT CELL WIDTH?NO

DONE
```

APPENDIX 3.

PROGRAM NAME: $+TTEST

GENERAL DESCRIPTION:

This program compares two samples to see if they are from the same population. The samples are not paired and need not be the same size. The significance of the difference between the means is tested by students t-test. The mean and standard deviation for each sample is determined. If desired, a plot of the normal curve based on the description of each sample will be plotted over the interval selected by the user.

PROGRAM LIMITATIONS:

A maximum of 50 observations per sample.

PROGRAM HISTORY:

This program is a modified version of the HP library program $T-TEST to which a modified version of the HP library program $FGRAPH has been added.

HOW TO USE:

1. The first data statement gives each of the sample sizes. The sample sizes need not be the same. The following data statements give each of the observations for each sample. Give all of the observations for the first sample, then for the second.
2. To get the analysis program, type

   APPEND-$+TTEST
3. To run the program, type

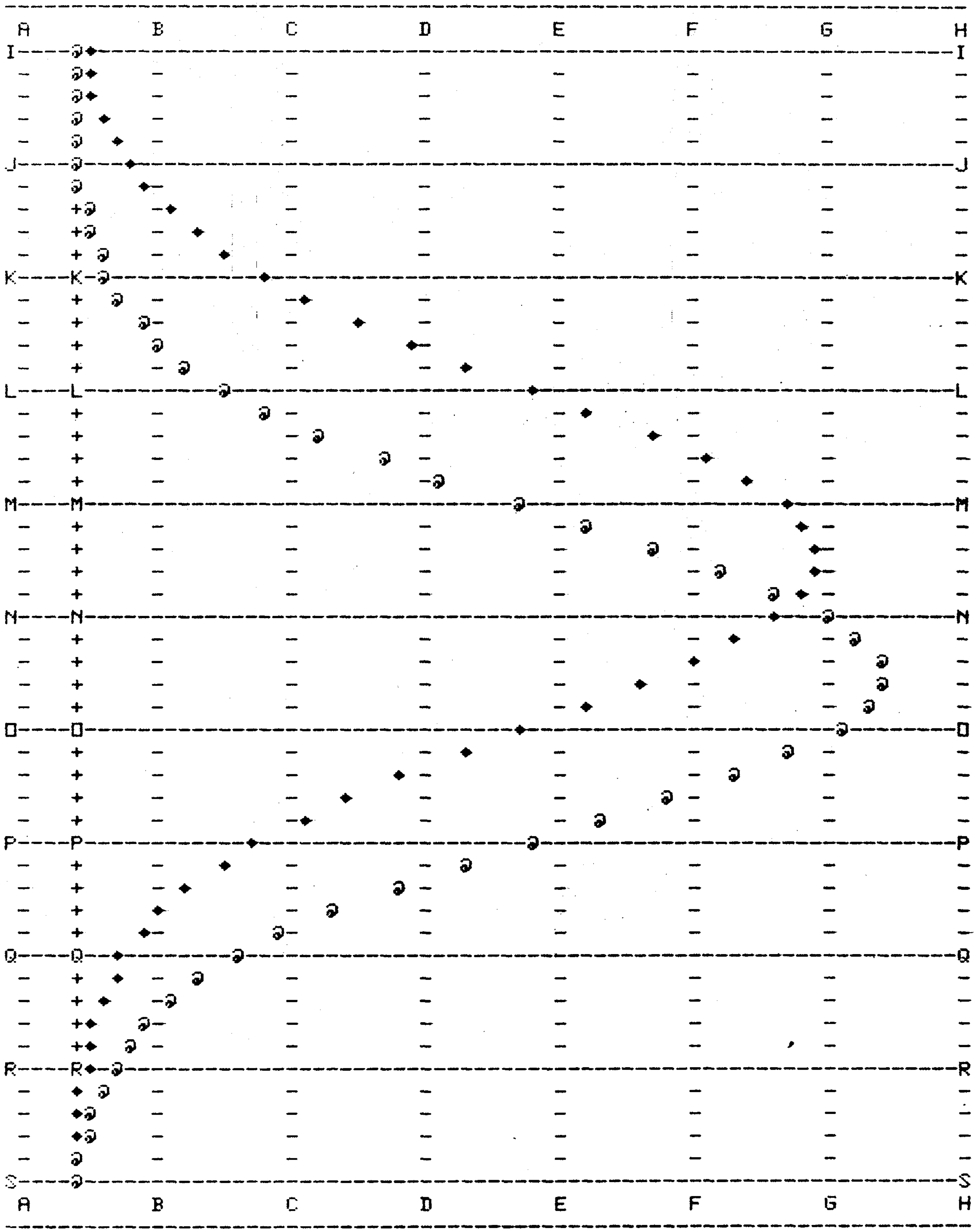
   RUN
4. To see how the program works on some example data, use the data-set named '$+EX02'.

EXAMPLE DATA-SET: $+EX02

```
10   REM *** EXAMPLE DATA FOR THE UNPAIRED T-TEST ANALYSIS
15   REM *** THE FIRST RECORD GIVES THE SAMPLE SIZES FOR THE TWO SAMPLES.
20   DATA 10,12
30   REM *** THE DHTH FUR THE FIRST SAMPLE FOLLOW.
40   DATA 12.3,14.2,15.4,9.5,11.2,9.4,13.9,8.9,10.3,12.1
50   REM *** THE DATA FOR THE SECOND SAMPLE FOLLOW.
60   DATA 17.5,13.4,15.8,11.2,14.3,12.6,13.4,13.9,10.2,11.6,11.4,14.2
70   REM *** NO MORE DATA **********
```

EXAMPLE RUN USING DATA-SET $+EX02:

```
SAMPLE          SAMPLE SIZE     MEAN            STANDARD DEQIATION
 1               10              11.72           2.24787
 2               12              13.2917         2.06902

 THE POOLED DEVIATION IS 2.15134     AND THE STUDENTS T
VALUES IS -1.7062      HT 20    DEGREES OF FREEDOM.
THE PROBABILITY OF THIS IS  .051726

THAT IS, THE SAMPLES ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 95% CONFIDENCE LEVEL, INDICATING THAT THEY
ARE PROBABLY FROM THE SAME POPULATION.


DO YOU WANT A PLOT OF THE TWO SAMPLE DESCRIPTIONS?YES


INPUT THE BEGINNING RND END POINTS FUR THE GRAPH?5,20
```


A B C D E F G H
I J K L M N O P Q R S
A B C D E F G H

X VALUES		Y VHLUES		SAMPLE KEY
I:	5	A:	-1.27699E-02	+--> SHMPLE 1
J:	6.5	B:	1.93118E-02	@--> SHMPLE 2
K:	8	C:	5.13934E-02	
L:	9.5	D:	8.34751E-02	
M:	11	E:	.115557	
N:	12.5	F:	.147638	
O:	14	G:	.17972	
P:	15.5	H:	.211802	
Q:	17			
R:	18.5			
S:	20			

DO YOU WANT TO TRY NEW END POINTS?NO

DUNE

APPENDIX 4.

PROGRAM NAME: $+ANOV1

GENERAL DESCRIPTION:

A one-way analysis of variance is performed with this program. This program uses a randomized design. The user supplies the number of treatments, the number of observations per treatment (they need not be the same), and the observation values themselves. The sums of squares and degrees of freedom are given for the treatments and the error. The F value is calculated and its probability given.

PROGRAM LIMITATIONS:

A maximum of 20 treatments and 50 observations per treatment may be used with this program.

PROGRAM HISTORY:

This is an unmodified version of the HP library program $ANVAR1.

HOW TO USE:

1. Build a data-set in the following form:

    10 DATA T   where T is the number of treatments

    20 DATA N1,N2,N3, ...NT

    where the NX's are the number of observations for each treatment

    30 DATA O1,O2, ...ON1

    40 DATA O1,O2, ...ON2

    and so on   where these are the observations for each treatment

2. NAME the data-set and SAVE it.
3. To run, append the program $+ANOV1 and run by typing

    APPEND-$+ANOV1

    RUN

4. To see how the program works on some example data, use the data-set named '$+EXO3'.

EXAMPLE DATA-SET: $+EX03

```
10  REM ***** EXAMPLE DATA FOR $+ANOV1
20  REM ***** THE NUMBER OF TREATMENTS:
30  DATA 5
40  REM ***** THE NUMBER OF OBSERVATIONS PER TREATMENT
50  DATA 2,6,11,4,2
60  REM ***** THE OBSERVATIONS, ONE TREATMENT IS GIVEN PER LINE
70  DATA 83,85
80  DATA 84,85,86,86,87,86
90  DATA 87,87,87,88,88,88,88,88,85,88,90
100  DATA 89,90,90,91
110  DATA 90,92
120  REM ***** END OF THE DATA
```

EXAMPLE RUN USING DATA-SET $+EX03:

```
ANALYSIS OF VARIANCE TABLE

GRAND TOTAL= 2188     NO. OBS.= 25    MEAN= 87.52


SOURCE              SS              DF              MS

TREATMENTS          94.375          4               23.5337
ERROR               25.875          20              1.29375

TOTAL               120.25          24


F = 18.2367    ON 4    AND 20    DEGREES OF FREEDOM.
PROBABILITY OF F>= 18.2367    WITH 4    AND 20    D.F. IS 0

DONE
```

APPENDIX 5.

PROGRAM NAME: $+CURVE

GENERAL DESCRIPTION:

This is a least square regression program for alculating the regression coefficients for a straight line and six types of curves. The coefficients of the equations are given and the r^2 values. If a user chooses, he may see a table of the actual X and Y values, the calculated Y, and the percent difference for any of the types of curves. The user can also choose which types of curves he wants graphed, and over what X-range the graph should be constructed. All of the curve types are placed on the same graph with the same X and Y axis values.

PROGRAM LIMITATIONS:

The program is designed for a maximum of 50 pairs of X and Y values. The program is near its storage capacity in the machine and if comments are used, fewer pairs of values may be the actual limit. If the storage is exceeded, a message in the form of "OUT OF SPACE IN ..." will be printed. To try to get more space, type

DEL-5000,5130

and then RUN again.

PROGRAM HISTORY:

This is a combination of two HP library programs, $CURFIT and $FGRAPH, which have both been modified.

HOW TO USE:

1. Enter the observed X and Y values as numbered data statements such as the following.

   10 DATA X1,Y1,X2,Y2,X3,Y3, ...XN,YN

2. Be sure to NAME and SAVE your data-set.
3. To get the analysis program, type

   APPENDIX-$+CURVE

4. To run the program, type

   RUN

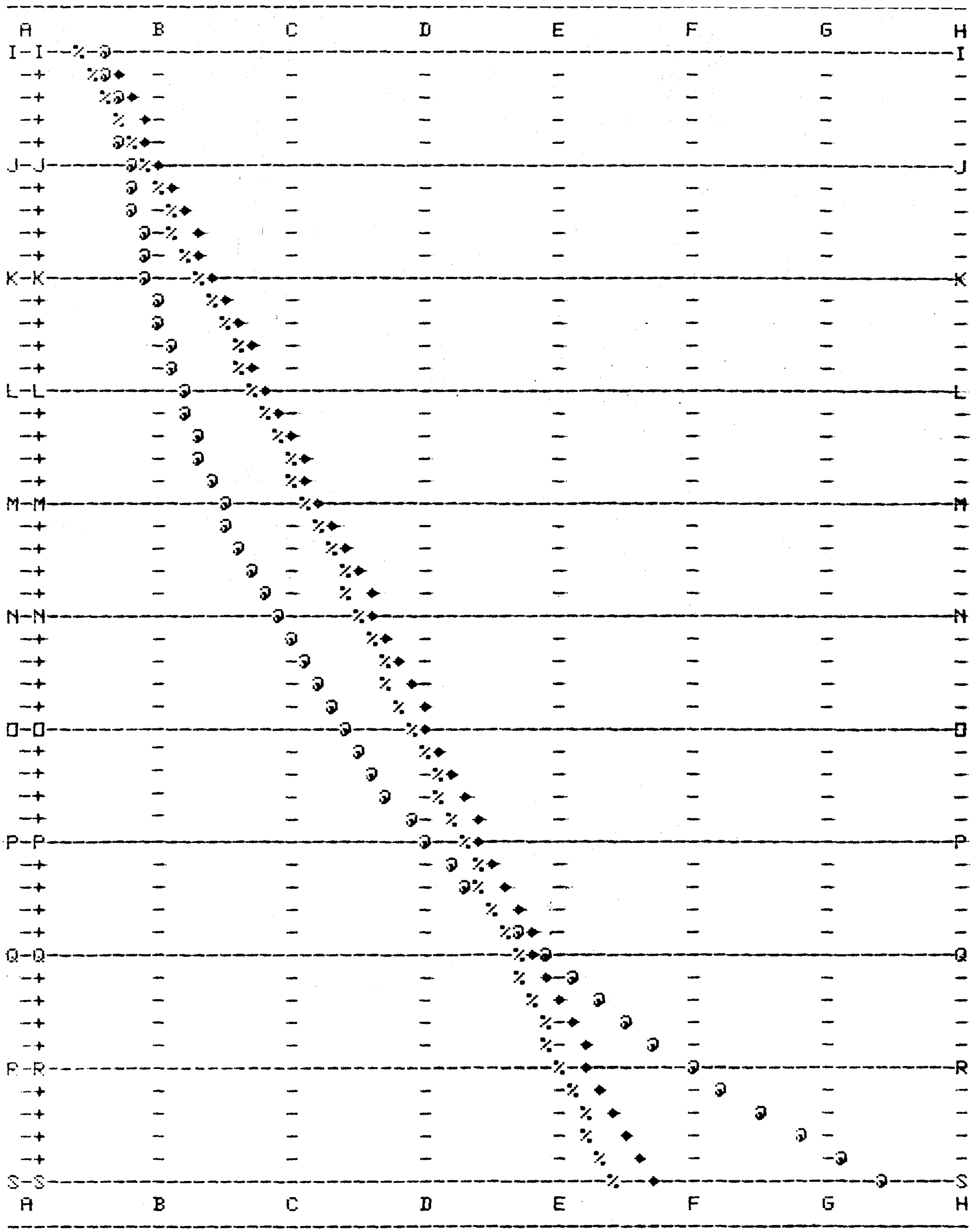
5. To see how the program works on some example data, use the data-set named '$+EX04'.

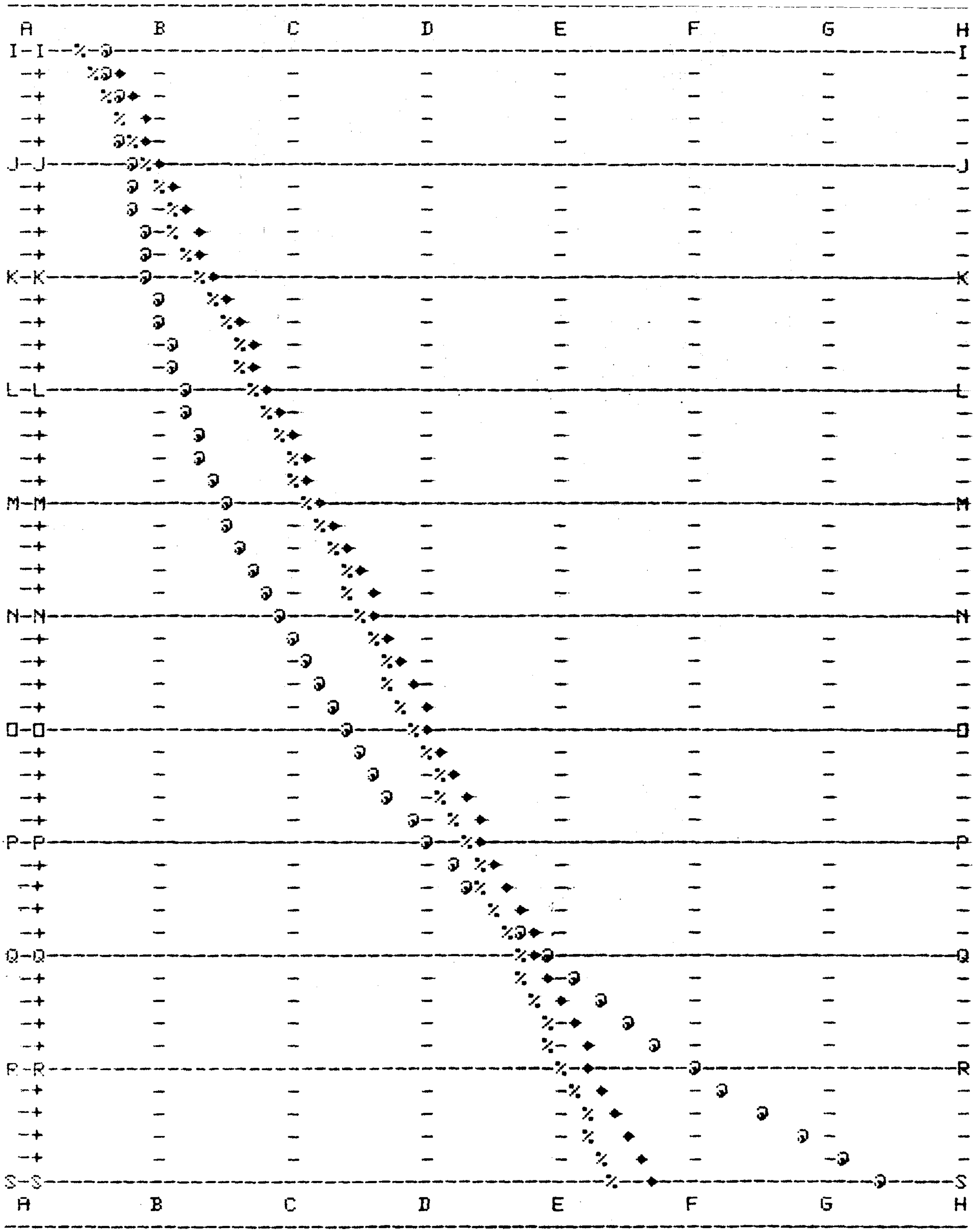
EXAMPLE DATA-SET: $+EX04

```
10  REM ******** EXAMPLE DATA FOR THE LEHST SQUARES REGRESSION
20  REM ******** THE X,Y POINTS HRE ENTERED AS NUMBERED DHTH STATEMENTS AS
30  REM ******** FOLLOWS:
40  DATA 1,1,6,2,10,6,13,11,17,15,21,14,24,10
50  REM ******** END DF DATA
```

EXAMPLE RUN USING DATA-SET $+EX04:

```
                  LEHST SQUARES CURVES FIT

CURVE TYPE        R SQUARED          A              B

1. Y=A+(B*X)      .704432         .939006         .569858
2. Y=A*EXP(B*X)   .769905         1.3688          .112336
3. Y=A*(X^B)      .862697         .814168         .889058
4. Y=A+(B/X)      .449942         10.7034        -10.675
5. Y=1/(A+B*X)    .693619         .753154        -3.56131E-02
6. Y=X/(A+B*X)    .883621         .945351         8.36415E-02
7. Y=A+B*LOG(X)   .67511         -.935242         4.17094

                  MEAN            STD DEV         FOR RRU DATA
X                 13.1429         8.19408
Y                 8.42857         5.56349

DO YOU WANT TO SEE THE DETAILS FUR A CURVE TYPE?YES
WHICH TYPE <ENTER ITS NUMBER>?3
   X-ACTUAL       Y-ACTUAL        Y-CALC          PCT DIFFER

 1                1               .814168                   22.8
 6                2               4.00438         -50
 10               6               6.30626         -4.8
 13               11              7.36295                   38.1
 17               15              10.1077                   48.4
 21               14              12.1967                   14.7
 24               10              13.7341         -27.1

DO YOU WANT TO SEE THE DETAILS FOR A CURVE TYPE?NO
DO YOU WANT TO GRAPH SOME OF THE CURVE TYPES?YES
ENTER THE NUMBER OF THE CURVE TYPES YOU WANT GRAPHED?1,2,3
INPUT THE BEGINNING AND END X-POINTS FOR THE GRAPH?1,24
```


A B C D E F G H
I J K L M N O P Q R S
A B C D E F G H


A B C D E F G H
I J K L M N O P Q R S

```
X VALUES          Y VALUES            CURVE TYPE
I:   1            A:  -.484052        ◆-->1
J:   3.3          B:   2.7615         @-->2
K:   5.6          C:   6.00705        %-->3
L:   7.9          D:   9.2526
M:   10.2         E:   12.4982
N:   12.5         F:   15.7437
O:   14.8         G:   18.9893
P:   17.1         H:   22.2348
Q:   19.4
R:   21.7
S:   24


DO YOU WANT TO TRY NEW END POINTS?NO

DONE
```

APPENDIX 6.

PROGRAM NAME: $+POLYR

GENERAL DESCRIPTION:

This program fits pairs of X and Y observations to a polynomial equation by a least squares method. The degree of the equation (i.e., the highest value of the exponent of X) is specified and the terms of the equation are successively added until this degree is reached. For example, if a degree of 3 is chosen, the linear equation is first fit, followed by the addition of a squared term, and finally the cubic term. The X and Y input values, the predicted Y, and the residual are printed at each step of the curve fitting.

The program actually has more capabilities than have been made available in the way it is currently set up to run. It may be set to use the Legendre polynomial and data may be weighted. Please list the program if you want to find out what modifications are required.

PROGRAM LIMITATIONS:

A maximum limit of 30 pairs of X and Y values is the design limit of the program.

PROGRAM HISTORY:

This program was supplied by P. Kroopnick and F. Riggs of the Department of Oceanography, UH.

HOW TO USE:

1. Enter the observed X and Y values as numbered data statements such as the following:

   10 DATA X1,Y1,X2,Y2,X3,Y3,...XN,YN
2. Be sure to NAME and SAVE your data-set.
3. To get the analysis program, type

   APPEND-$+POLYR
4. To run the program, type

   RUN
5. To see how the program works on some example data, use the data-set named '$+EX05'.

EXAMPLE DATA-SET: $+EX05

```
10  REM ******** EXAMPLE DATA FOR THE POLYNOMIAL LEAST SQUARES REGRESSION
20  PEM ******** THE X,Y POINTS HRE ENTERED AS NUMBERED DATA STATEMENTS AS
30  REM ******** FOLLOWS:
40  DATA 1,1,6,2,10,6,13,11,17,15,21,14,24,10
50  REM ******** END OF DATA
```

EXAMPLE RUN USING DATA-SET $+EX05:

```
INPUT HIGHEST DECREE DESIRED?2



COEFICIENTS OF Y=B1+B2*X+. ..+BK*X^(K-1) AND STD. DEV.

B 1      .939007      ERR  2.50503
B 2      .569858      ERR  .165073

 STD. DEV. ABOUT THE LINE =  3.31334

NO.        X VALUE      Y VALUE     Y PREDICTED    RESIDUAL       WEIGHT

 1          1            I           1.50887        .308865        1
 2          6            2           4.35816        2.35816        1
 3          10           6           6.63759        .637589        1
 4          13           11          8.34716       -2.65284        1
 5          17           15          10.6266       -4.3734         1
 6          21           14          12.906        -1.09397        1
 7          24           10          14.6156        4.6156         1



COEFICIENTS OF Y=B1+B2*X+...+BK*X^(K-1) AND STD. DEV.

E l     -2.42015      ERR  3.15335
B 2      1,39512      ERR  .565968
B 3     -3.25124E-02    ERR  2.15288E-02

 STD. DEV. ABOUT THE LINE =  2.95631

NO.        X VALUE      Y VALUE     Y PREDICTED    RESIDUAL       WEIGHT

 1          1            1          -1,05754       -2.05754        1
 2          6            2           4.78013        2.78013        1
 3          10           6           8.27981        2.27981        1
 4          13           11          10.2218       -.778185        1
 5          17           15          11.9008       -3.09919        1
 6          21           14          12.5394       -1.4606         1
 7          24           10          12.3356        2.33553        1

DUNE
```

APPENDIX 7.

PROGRAM NAME: $+MULTR

GENERAL DESCRIPTION:

Multiple linear regressions and correlations are calculated with this program. The means and standard deviations of the variables are calculated. The correlation coefficient matrix, variance-covariance matrix, the parameters of the best-fit line and the r^2 value are given. A table of the values of the dependent variable, the predicted value and the residuals may also be printed.

PROGRAM LIMITATIONS:

A maximum of 9 independent variables and a maximum of 50 sets of observations may be analyzed.

PROGRAM HISTORY:

The program was originally from the HP library. In its distributed version, however, it was too large to fit the present computer configuration. Steve Bern (UH Bus Ed) modified the program by reading the data into a file with a driver program and then chaining to the main analysis program. This version is currently the one used.

HOW TO USE:

1. Prepare sequence numbered data statements in the following form:

10 DATA N,M,R where N is the number of sets of observations,
M is the observations in each set,
R is the number of regressions to be run

20 DATA O1,O2,...OM where the O's are the observations of a set

30 DATA O1,O2,...OM where these are the second set of observations and so on for the N-number of sets

40 DATA I,I2,P1,P2,N1,N2,...NI2,D

where I is the number of the run,
I2 is the number of independent variables to be used in the regression,
P1 is 1 if variance-covariance matrix is to be printed (else 0 for no print),
P2 is 1 if the observations vs predicted list of the dependent variable is to be printed (else 0 for no print),

N1,N2,...N12 are the numbers of the independent variables to be used, and D is the number of the dependent variable.

2. NAME and SAVE the data-set.
3. To get the analysis program, type

   APPEND-$+MULTR

4. To run the program type

   RUN

5. To see how the program works on some example data, use the data-set named '$+EX04'.

EXAMPLE DATA-SET: $+EX06

```
10 REM *** EXAMPLE DATA FUR $+MULTR - THE MULTIPLE REGRESSION PROGRAM
20 REM ** THE FIRST DHTR STATEMENT GIVES THE NUMBER OF SETS OF OBSERVATIONS,
30 REM ** THE NUMBER OF OBSERVATIONS IN EACH SET, AND THE NUMBER OF RUNS
40 REM ** TO BE MADE ON THE DATA WITH DIFFERENT INDEPENDENT VARIABLES.
50 DATA 13,5,3
60 RER ** EACH OF THE OBSERVATIONS FOLLOWS.  EACH SET IS ON A SEPARATE LINE
70 REM ** IN THIS EXAMPLE.
80 DHTR 7,26,6,60,78.5
90 DATA 1,29,15,52,74.3
100 DATR 11,56,8,20,104.3
110 DHTR 11,31,8947,87.6
120 DATF) 7,52,6,33,95.9
130 DATA 11,55,9 9 22,109.2
140 DATA 3,71,17,6,102.7
150 DATR 1,31,22,44,72.5
160 DATA 2,54,18,22,93.1
170 DATA 21,47,4,26,115.9
180 DATA 1,40,239 34983.8
190 DATA 11,66,9,12,113.3
200 DATA I0,68,8,12,109.4
210 REM ** THE CHOICE OF THE RUN PARAMETERS FOLLOWS.  THE NUMBER OF CHOICES
220 REM ** WAS GIVEN AS THE THIRD PARAMETER OF THE FIRST DATA STATEMENT.
230 REM ** THE PARAMETERS ARE AS FOLLOWS:
240 REM ** THE NUMBER OF THE RUN, THE NUMBER OF INDEPENDENT VARIABLES TD
250 REM ** BE USED IN THE RUN, THE PRINT OPTION FUR THE VARIANCE-COVARIANCE
260 REM ** MATRIX (1=YES, 0=NO), THE PRINT OPTION FUR THE OBSERVED VS.
270 REM ** PREDICTED LISTING (1=YES, 0=NO), A SET OF NUMBERS EACH GIVING
280 REM ** THE NUMBER OF THE INDEPENDENT VARIABLE TO BE INCLUDED IN THE
290 REH ** RUN (NOTE THAT THERE SHOULD BE X NUMBERS IF X WAS THE VALUE
300 REH ** OF THE SECOND PARAMETER, AND THE NUMBER OF THE DEPENDENT VARIABLE
310 REM ** FOR THE FIRST RUN, THE SPECIFICATION IS AS FOLLOWS:
320 REM ** RUN NUMBER 1, 4 INDEPENDENT VARIABLES TO BE USED, PRINT THE
330 REM ** VARIANCE-COVARIANCE MATRIX, DO NOT PRINT THE OBSERVED
340 REM ** AND PREDICTED DEPENDENT VARIABLE LIST, THE NUMBERS OF THE
350 REM ** INDEPENDENT VARIABLES TO BE USED ARE 1,2,3,4 AND THE 5TH VARIABLE
360 REH ** IS THE DEPENDENT VARIABLE.
370 DATR 1,4,1,0,1,2,3,4,5
380 DHTR 2,1,0,0,1,5
390 DATF) 3,2,0,1,1,2,5
400 REM *** END OF THE EXAMPLE DATA
```

EXAMPLE RUN USING DATA-SET $+EX06:

**REGRESSION NUMBER 1 :DEPENDANT VARIABLE IS 5

INDEX	MEAN	STANDARD DEVIATIONS
1	7.46154	5.88239
2	48.1538	15.5609
3	11.7692	6.40513
4	30	16.7382
5	95.4231	15.0437

CORRELATION COEFFICIENTS

	.22858		5445	
22858		9242	972956	816254
4133	9242	99999	029537	534672
45	972956	029537	1.	-.821311
19	6255	534672	21311	1.00001

VARIANCE-COVARIANCE MATRIX

4911.1	-50.5187	-50.6145	-51.6721	-49.6089
-50.5186	,554809	,512775	,554371	,505407
-50.6146	.512776	,523994	.525825	,512252
-51 ,672	,554372	.525824	,569716	.516939
-49.6089	,505408	.512252	.516993	.502875

INDEX	B	STD. ERROR	T-RATIO
0	62 .5736	70,0793	832897 .
1	1 .54939	.744855	2.08012
2	,50843	.723874	.702373
3	.100156	,754796	,132693
4	- ,145764	,709137	-.205552

R-SQUARED= .982371 R= .991146

STAND. ERROR OF EST.= 2.44632 D.F.= 8

**REGRESSION NUMBER 2 :DEPENDANT VARIABLE IS 5

INDEX	MEAN	STANDARD DEVIATIONS
1	7.46154	5.88239
5	95,4231	15.0437

CORRELATION COEFFICIENTS

1.	.730719
.730719	1.00001

INDEX	B	STD. ERROR	T-RATIO
0	81,4794	4.92735	16.5362
1	1,86875	.526408	3,54999

R-SQUARED= .533944 R= .730715

STAND. ERRUR OF EST.= 10.7267 D.F.= 11

DURBIN-WATSON STAT.= 1.71579

**REGRESSION NUMBER 3 :DEPENDANT VARIABLE IS 5

INDEX	MEAN	STANDARD DEVIATIONS
1	7.46154	5.88239
2	48.1538	15.5609
5	95.423 1	15. 0437

CORRELATION COEFFICIENTS

1.	.22858	.730719
.22858	1.	.816254
.730719	.8162.55	1.00001

INDEX	B	STD. ERROR	T-RATIO
0	52.5775	2.28652	22.9946
1	1.46831	.121319	12.1028
2	.662248	4.58616E-02	14.4401

R-SQUARED= .978672 R= .989279

STAND. ERROR OF EST.= 2.4067 D.F.= 10

ACTUAL	PREDICTEII	RESIDUAL
78.5	80.0741	-1.57406
74.3	73.251	1. 04903
104.3	105.815	-1.51471
87.6	89.2585	-1.65852
95.9	97.2'325	-1.39251
109.2	105.152	4.04753
102.7	104.002	-1.30199
72.5	74.5755	-2. 07547
93 .1	91.2735	1.82454
115.9	114.538	1.36245
83.8	80.5357	3.26431
113.3	112.437	.862816
103.4	112.293	-2.89339

DURBIN-WATSON STAT.= 1.92106

*****PROBLEM COMPLETED*****

DONE

APPENDIX 8.

PROGRAM NAME: $+CONTG

GENERAL DESCRIPTION:

This program is used to test data for an R x C contingency table. The expected values are determined and compared with the observed table values and the Chi-square value obtained. This program also calculates the probability of this Chi-square value for the appropriate number of degrees of freedom.

PROGRAM LIMITATIONS:

A maximum of 20 rows and 20 columns may be used.

PROGRAM HISTORY:

This program was modified from J. Peters (Biostatistical Programs in BASIC Language for Time-shared Computers, Smithsonian Contributions to Zoology Number 69) program SIP318. The Chi-square probability calculation was obtained from the HP library program $CHISQ.

HOW TO USE:

1. Enter the number of rows and columns as the two values of the first data statement. A maximum of 20 for each of these values.
2. Enter the observations for each of the columns of the first row on the next numbered data statement. Continue adding the column observations for each of the rows until each of the rows has been entered.
3. Be sure to NAME and SAVE your data-set.
4. To get the analysis program, type

   APPEND-$+CONTG
5. To run the program, type

   RUN
6. To see how the program works on some example data, use the data-set named '$+EX07'.

EXAMPLE DATA-SET: $+EX07

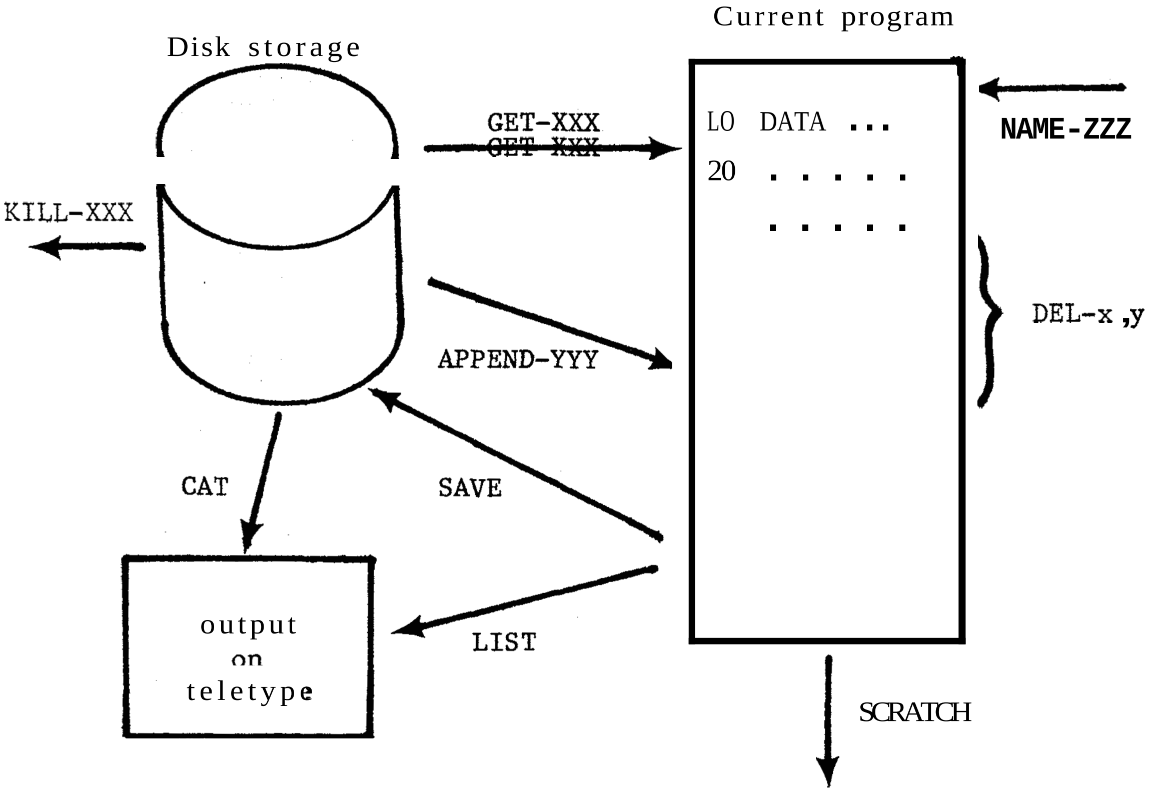
```
10  REM ***** CONTINGENCY TABLE PROGRAM ($+CONTG) TEST DATA
11  REM *** FIRST? THE NUMBER OF ROWS, AND COLUMNS
12  DATA 2,2
13  REM *** NOW THE OBSERVATIONS AS THE COLUMNS IN EHCH ROW, WITH
14  REM *** SUCCESSIVE DATA STATEMENTS BEING NEW ROWS.
15  DHTH 1,10
16  DATA 8,3
17  REM *** END OF THE DATA
```

EXAMPLE RUN WITH DATA-SET $+EX07:

```
DO YOU WANT TO USE THE SMALL SAMPLE CORRECTION?YES

CHI SQUARE IS 6.76323     WITH 1 DEGREE [redacted] FREEDOM

THE EXACT PROBABILITY IS  .00923

DO YOU WANT A LIST OF THE CALCULATED EXPECTED VALUES?YES

ROW          COL          OBS          EXP
 1            1            1            4.5
 1            2            10           6.5
 2            1            8            4.5
 2            2            3            6.5

DONE
```

APPENDIX 9.

SUMMARY OF OPERATIONS



GET-XXX	Copies program named XXX from the disk file storage to the current program. Gives the current program the same name as the name under which it was stored.
APPEND-YYY	Appends the stored program named YYY to the end of the current program. The name is not changed.
NAME-ZZZ	Names the current program ZZZ.
KILL-XXX	Removes the specified program (XXX) from the disk storage. It does not change the current program.
SAVE	Copies the current program to the disk storage and saves it with the name of the current program. If the name already is used to store a program (perhaps an earlier version), the stored version must first be KILLed and then the current program SAVEd. Otherwise give the current program a new NAME and then SAVE it.
SCRATCH	Empties the current program. No sequence numbered statements remain.
DEL-x ,y	Deletes the range of sequence numbered statements specified as x and y. To remove just one statement, just type its number, then press the carriage return key.
CAT	Lists the programs stored under the users account number.
LIST	Lists the statements of the current program.

TECHNICAL REPORTS OF THE US/IBP ISLAND ECOSYSTEMS IRP
(Integrated Research Program)

*No. 1 Hawaii Terrestrial Biology Subprogram. First Progress Report and Second-Year Budget. D. Mueller-Dombois, ed. December 1970. 144 p.

*No. 2 Island Ecosystems Stability and Evolution Subprogram. Second Progress Report and Third-Year Budget. D. Mueller-Dombois, ed. January 1972. 290 p.

*No. 3 The influence of feral goats on koa (Acacia koa Gray) reproduction in Hawaii Volcanoes National Park. G. Spatz and D. Mueller-Dombois. February 1972. 16 p.

*No. 4 A non-adapted vegetation interferes with soil water removal in a tropical rain forest area in Hawaii. D. Mueller-Dombois. March 1972. 25 p.

*No. 5 Seasonal occurrence and host-lists of Hawaiian Cerambycidae. J. L. Gressitt and C. J. Davis. April 1972. 34 p.

*No. 6 Seed dispersal methods in Hawaiian Metrosideros. Carolyn Corn. August 1972. 19 p.

*No. 7 Ecological studies of Ctenosciara hawaiiensis (Hardy) (Diptera: Sciaridae). W. A. Steffan. August 1972. 7 p.

*No. 8 Birds of Hawaii Volcanoes National Park. A. J. Berger. August 1972, 49 p.

*No. 9 Bioenergetics of Hawaiian honeycreepers: the Amakihi (Loxops virens) and the Anianiau (L. parva). R. E. MacMillen. August 1972. 14 p.

*No. 10 Invasion and recovery of vegetation after a volcanic eruption in Hawaii. G. A. Smathers and D. Mueller-Dombois. September 1972. 172 p.

*No. 11 Birds in the Kilauea Forest Reserve, a progress report. A. J. Berger. September 1972. 22 p.

No. 12 Ecogeographical variations of chromosomal polymorphism in Hawaiian populations of Drosophila immigrans. Y. K. Paik and K. C. Sung. February 1973. 25 p.

*No. 13 The influence of feral goats on the lowland vegetation in Hawaii Volcanoes National Park. D. Mueller-Dombois and G. Spatz. October 1972. 46 p.

*No. 14 The influence of SO_2 fuming on the vegetation surrounding the Kahe Power Plant on Oahu, Hawaii. D. Mueller-Dombois and G. Spatz. October 1972. 12 p.

No. 15 Succession patterns after pig digging in grassland communities on Mauna Loa, Hawaii. G. Spatz and D. Mueller-Dombois. November 1972. 44 p.

No. 16 Ecological studies on Hawaiian lava tubes. F. G. Howarth. December 1972. 20 p.

No. 17 Some findings on vegetative and sexual reproduction of koa. Günter O. Spatz. February 1973. 45 p.

No. 18 Altitudinal ecotypes in Hawaiian Metrosideros. Carolyn Corn and William Hiesey. February 1973. 19 p.

No. 19 Some aspects of island ecosystems analysis. Dieter Mueller-Domboia. February 1973. 26 p.

No. 20 Flightless Dolichopodidae (Diptera) in Hawaii. D. Elmo Hardy and Mercedes D. Delfinado. February 1973. 8 p.

* out of print

No. 21 Third Progress Report and Budget Proposal for FY 74 and FY 75. D. Mueller-Dombois and K. Bridges, eds. March 1973. 153 p.

No. 22 Supplement 1. The climate of the IBP sites on Mauna Loa, Hawaii. Kent W. Bridges and G. Virginia Carey. April 1973. 141 p.

No. 23 The bioecology of Psylla uncatoides in the Hawaii Volcanoes National Park and the Acacia ~~koaia~~ Sanctuary. John R. Leeper and J. W. Beardsley. April 1973. 13 p.

No. 24 Phenology and growth of Hawaiian plants, a preliminary report. Charles H. Lamoureux. June 1973. 62 p.

No. 25 Laboratory studies of Hawaiian Sciaridae (Diptera). Wallace A. Steffan. June 1973. 17 p.

No. 26 Natural area system development for the Pacific region, a concept and symposium. Dieter Mueller-Dombois. June 1973. 55 p.

No. 27 The growth and phenology of Metrosideros in Hawaii. John R. Porter. August 1973. 62 p.

*No. 28 EZPLOT: A computer program which allows easy use of a line plotter. Kent W. Bridges. August 1973. 39 p.

No. 29 A reproductive biology and natural history of the Japanese white-eye (Zosterops japonica japonica) in urban Oahu. Sandra J. Guest. September 1973. 95 p.

No. 30 Techniques for electrophoresis of Hawaiian Drosophila. W. W. M. Steiner and W. E. Johnson. November 1973. 21 p.

No. 31 A mathematical approach to defining spatially recurring species groups in a montane rain forest on Mauna Loa, Hawaii. Jean E. Maka. December 1973. 112 p.

*No. 32 The interception of fog and cloud water on windward Mauna Loa, Hawaii. James O. Juvik and Douglas J. Perreira. December 1973. 11 p.

No. 33 Interactions between Bawaiian honeycreepers and Metrosideros collina on the island of Hawaii. F. Lynn Carpenter and Richard E. MacMillen. December 1973. 23 p.

No. 34 Floristic and structural development of native dry forest stands at Mokulcia, N.W. Oahu. Nengah Wirawan. January 1974. 49 p.

No. 35 Genecological studies of Hawaiian ferns: reproductive biology of pioneer and non-pioneer species on the island of Hawaii. Robert M. Lloyd. February 1974. 29 p.

No. 36 Fourth Progress Report and Budget Proposal for N 1975. D. Mueller-Dombois and K. Bridges, eds. March 1974. 44 p.

No. 37 A survey of internal parasites of birds on the western slopes of Diamond Head, Oahu, Hawaii 1972-1973. H. Eddie Smith and Sandra J. Guest. April 1974. 18 p.

No. 38 Climate data for the IBP sites on Mauna Loa, Hawaii. Kent W. Bridges and G. Virginia Carey. May 1974. 97 p.

No. 39 Effects of microclimatic changes on oogenesis of Drosophila mimica. Michael P. Kambysellis. May 1974. 58 p.

No. 40 The cavernicolous fauna of Hawaiian lava tubes, Part VI. Mesoveliidae or water treaders (Heteroptera). Wayne C. Gagné and Francis G. Howarth. May 1974. 22 p.

* out of print

No. 41 Shade adaptation of the Hawaiian tree-fern (Cibotium glaucum (Sm.) H. & A.). D. J. C. Friend. June 1974. 39 p.

No. 42 The roles of fungi in Hawaiian Island ecosystems. I. Fungal communities associated with leaf surfaces of three endemic vascular plants in Kilauea Forest Reserve and Hawaii Volcanoes National Park, Hawaii. Gladys E. Baker, Paul H. Dunn and William A. Sakai. July 1974. 46 p.

No. 43 The cavernicolous fauna of Hawaiian lava tubes, Part VII. Emesinae or thread-legged bugs (Heteroptera: Redvuiidae). Wayne C. Gagné and Francis G. Howarth. July 1974. 18 p.

No. 44 Stand structure of a montane rain forest on Mauna Loa, Hawaii. Ranjit G. Cooray. August 1974. 98 p.

No. 45 Genetic variability in the Kilauea Forest population of Drosophila silvestris. E. M. Craddock and W. E. Johnson. September 1974. 39 p.

No. 46 Linnet breeding biology on Hawaii. Charles van Riper 111. October 1974. 19 p.

No. 47 The nesting biology of the House Finch, Carpodacus mexicanus frontalis (Say), in Honolulu, Hawaii. Lawrence T. Hirai. November 1974. 105 p.

No. 48 A vegetational description of the IBP small mammal trapline transects - Mauna Loa Transect. James D. Jacobi. November 1974. 19 p.

No. 49 Vegetation types: a consideration of available methods and their suitability for various purposes, Dieter Mueller-Dombois and Heinz Ellenberg. November 1974. 47 p.

No. 50 Genetic structure and variability in two species of endemic Hawaiian Drosophila. William W. M. Steiner and Hampton L. Carson, December 1974. 66 p.

No. 51 Composition and phenology of the dry forest of Mauna Kea, Hawaii, as related to the annual cycle of the Amakihi (Loxops virens) and Palila (Psittirostra bailleui). Charles van Riper 111. January 1975. 37 p.

No. 52 Environment-enzyme polymorphism relationships in two Hawaiian Drosophila species. W. W. M. Steiner. January 1975. 28 p.

No. 53 A review of the Hawaiian Coccinellidae. John R. Leeper. February 1975. 54 p.

No. 54 Integrated island ecosystem ecology in Hawaii - Introductory Survey. Part I of proposed synthesis volume for US/IBP series. Dieter Mueller-Dombois. February 1975. 46 p.

No. 55 Soil algal relationships to Onychiurus folsomi, a minute arthropod. Linda-Lee McGurk. March 1975. 66 p.

No. 56 Cytogenetics of the Hawaiian Telmatogeton (Diptera). Lester J. Newman. March 1975. 23 p.

No. 57 Electrophoretic variability in island populations of Drosophila simulans and Drosophila immigrans. William W. M. Steiner, Ki Chang Sung and Y. K. Paik. March 1975. 20 p.

No. 58 Acari on murine rodents along an altitudinal transect on Mauna Loa, Hawaii. Frank J. Radovsky, JoAnn M. Tenorio, P. Quentin Tomich, and James D. Jacobi. April 1975. 11 p.

No. 59 Climate data for the IBP sites on Mauna Loa, Hawaii. Kent W. Bridges and G. Virginia Carey. April 1975. 90 p.

No. 60 Oxygen consumption, evaporative water loss and body temperature in the Sooty Tern, Sterna fuscata. Richard E. MacMillen, G. Causey Whittow, Ernest A. Christopher and Roy J. Ebisu. April 1975. 15 p.

No. 61 Threshold model of feeding territoriality: a test with an Hawaiian honeycreeper. F. L. Carpenter and R. E. MacMillen. April 1975. 11 p.

No. 62 Parasites of the Hawaii Amakihi (Loxops virens virens). Charles van Riper, April 1975. 25 p.

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